



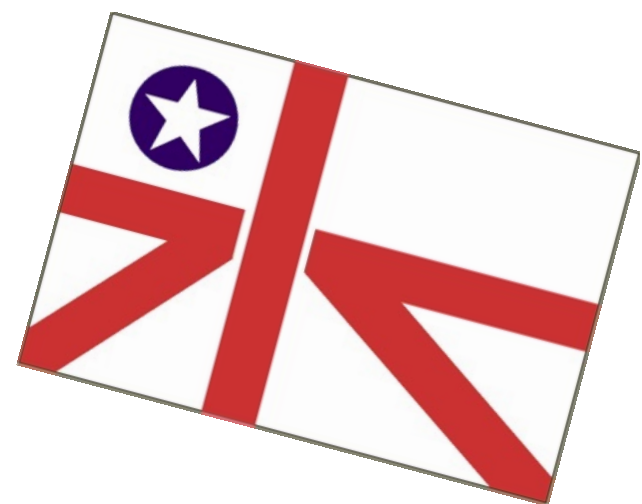
Marine pollution and environmental Issues in the Gulf of Thailand

2025 SEAFDEC Training Program (2025-05-20)

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What is Pollution?

Environmental pollution occurs when harmful substances or energy—like chemicals, waste, heat, noise, or radiation—are released into the environment faster than nature can safely break them down or make them harmless

Marine pollution occurs when harmful substances or energy—like chemicals, waste, heat, noise, or radiation—are released into the MARINE environment faster than nature can...

*~80% of marine pollution comes **from land-based sources***



Where does pollution come from?

While natural events like forest fires or volcanoes can cause pollution, the term usually refers to pollution caused by human activities

*pollution can be **visible** and it
can be **invisible***



Major categories of pollution

1. **Air** Pollution
2. **Land** Pollution
3. **Light** Pollution
4. **Noise** Pollution
5. **Thermal** Pollution
6. **Visual** Pollution
7. **Water** Pollution

Air



http://www.visiontimes.com/uploads/2015/01/Benxi_Steel_Industries.jpg

Land



<https://pixfeeds.com/images/18/469117/1200-597647534-land-pollution.jpg>

Light



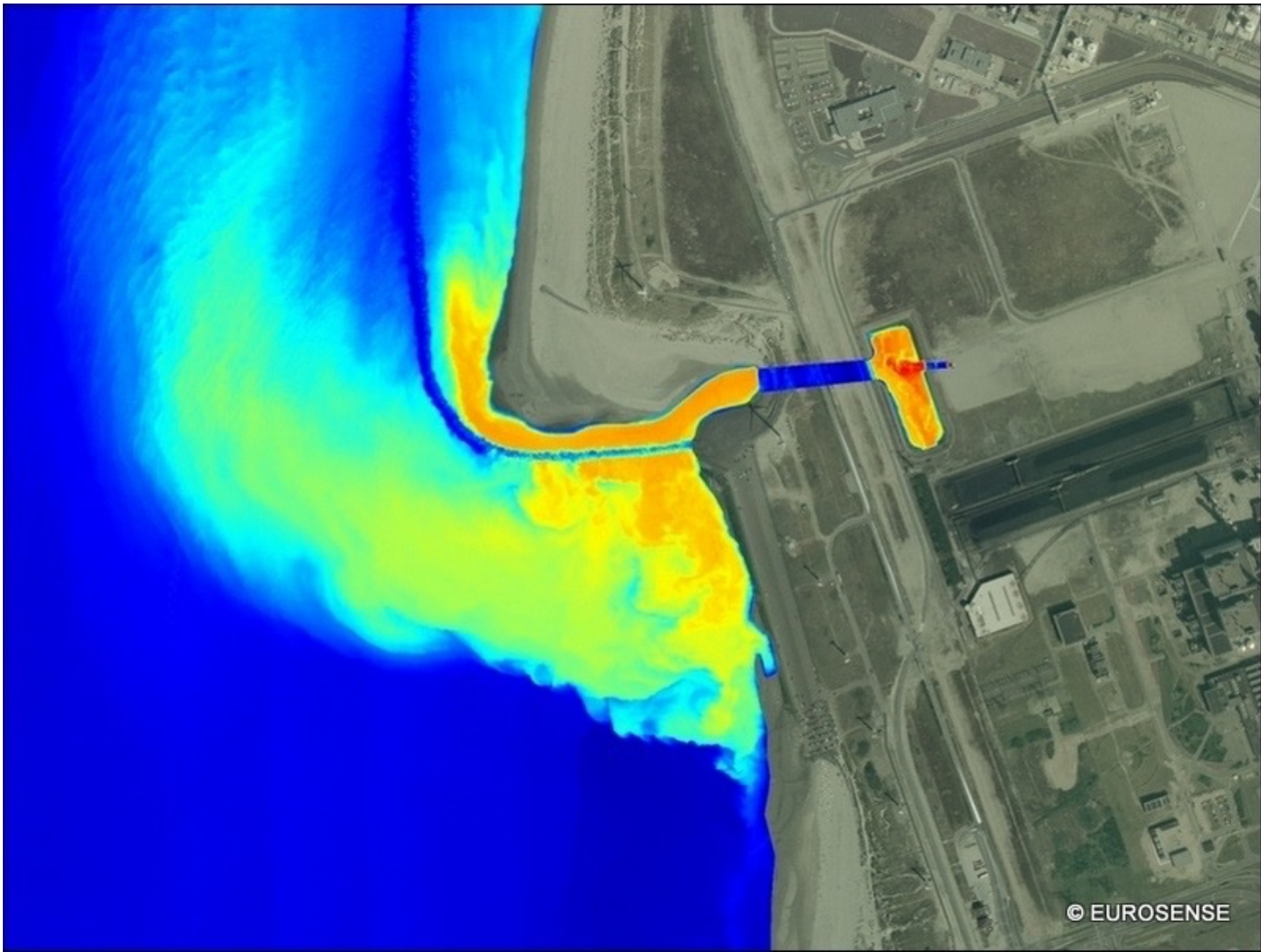
<http://penguinsix.com/wp-content/uploads/2012/04/lightpollute.png>

Noise



<https://www.citypassguide.com/media/slideshow/noise-pollution-1.jpg>

Thermal



http://www.eurosense.com/documents/graphics/images/your-application/water-management/hot_water_distribution_maasvlakte_eurosense_b.jpg

Visual



<https://understandingpollution.files.wordpress.com/2014/12/visual-pollution-2.jpg>

Water



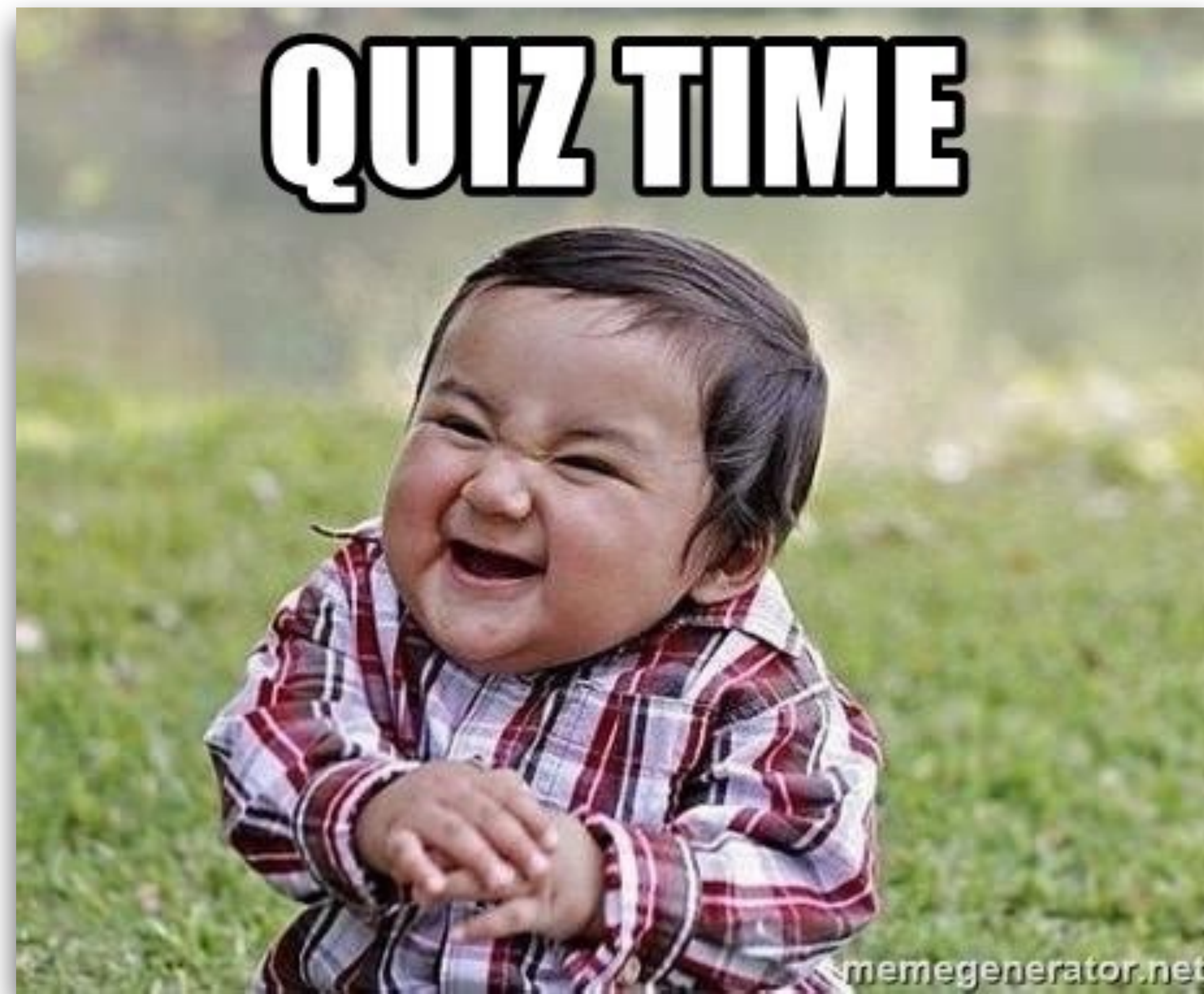
<http://cdn.yourarticlelibrary.com/wp-content/uploads/2013/12/b957.jpg>

The Marine Environment

- Oceans
- Estuaries

An estuary is where a river or stream meets the ocean. Here, freshwater mixes with salty seawater, creating **brackish** water—which is less salty than ocean water but saltier than freshwater





How many different categories of marine pollution can you identify?

Major sources of marine pollution

- Nutrients (Eutrophication)
- Marine Debris
- Oil & Related Chemicals
- Metals
- Pesticides and Industrial Organic Chemicals
- Emerging concerns
- Bioaccumulation & Biomagnification
- Climate Change & Ocean Acidification
- Biological Pollution

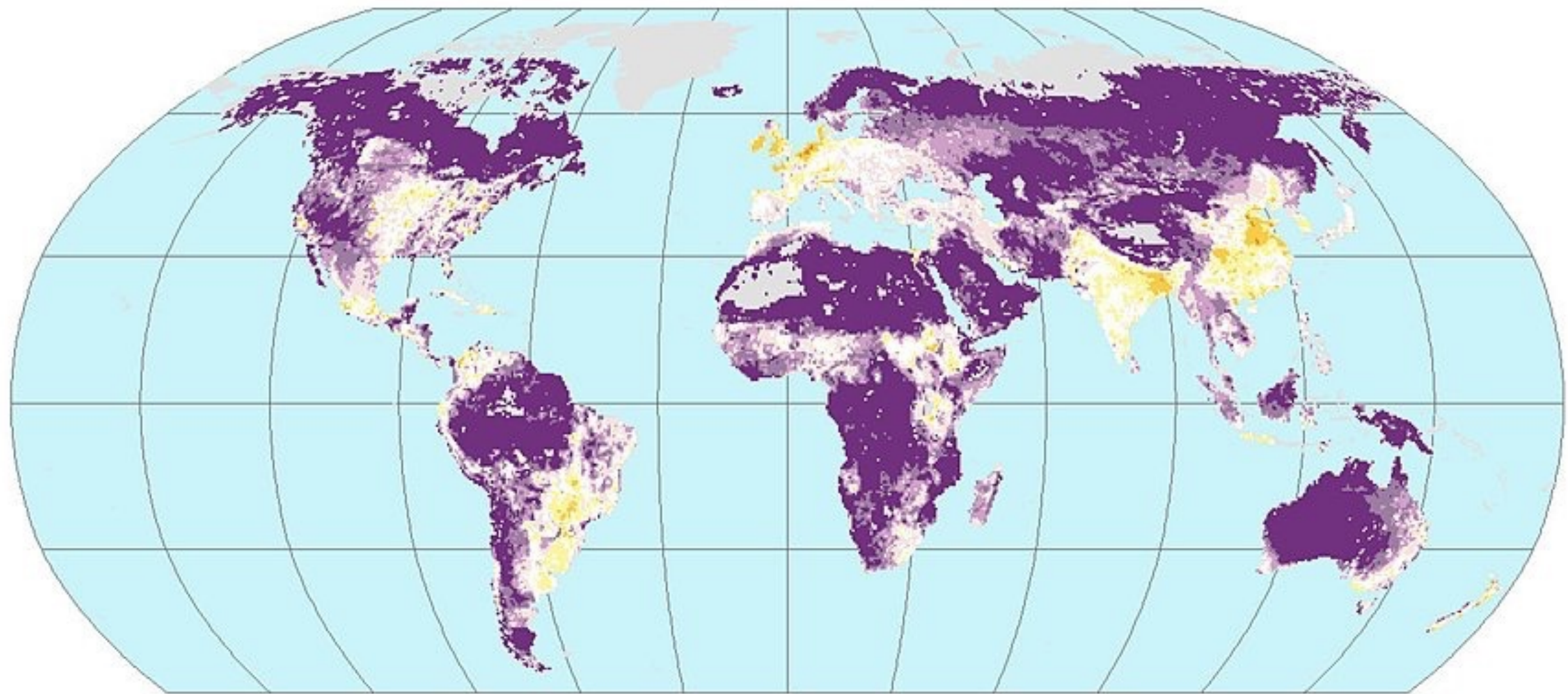


<https://www.greenpeace.org/international/story/44923/oil-is-leaking-all-over-the-world/>

https://1.bp.blogspot.com/-_FDct7dcfM/VsMKIsbumZI/AAAAAAAAAK4/iBIQt1xQVWU/s1600/ocean%2Bpollution.jpg

Global Nitrogen Fertilizer Application

Global Fertilizer and Manure, Version 1



Robinson Projection

Amount of nitrogen fertilizer applied averaged over all crops within the 0.5 deg grid cell. Grid cell values are expressed in kilograms per hectare (kg/ha) ranging from 0 to 370. The data values were computed by fusing global maps of harvested areas for 175 crops with national information on fertilizer use for each crop.

Kg/ha of Nitrogen Fertilizer applied per grid cell:



Center for International Earth
Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

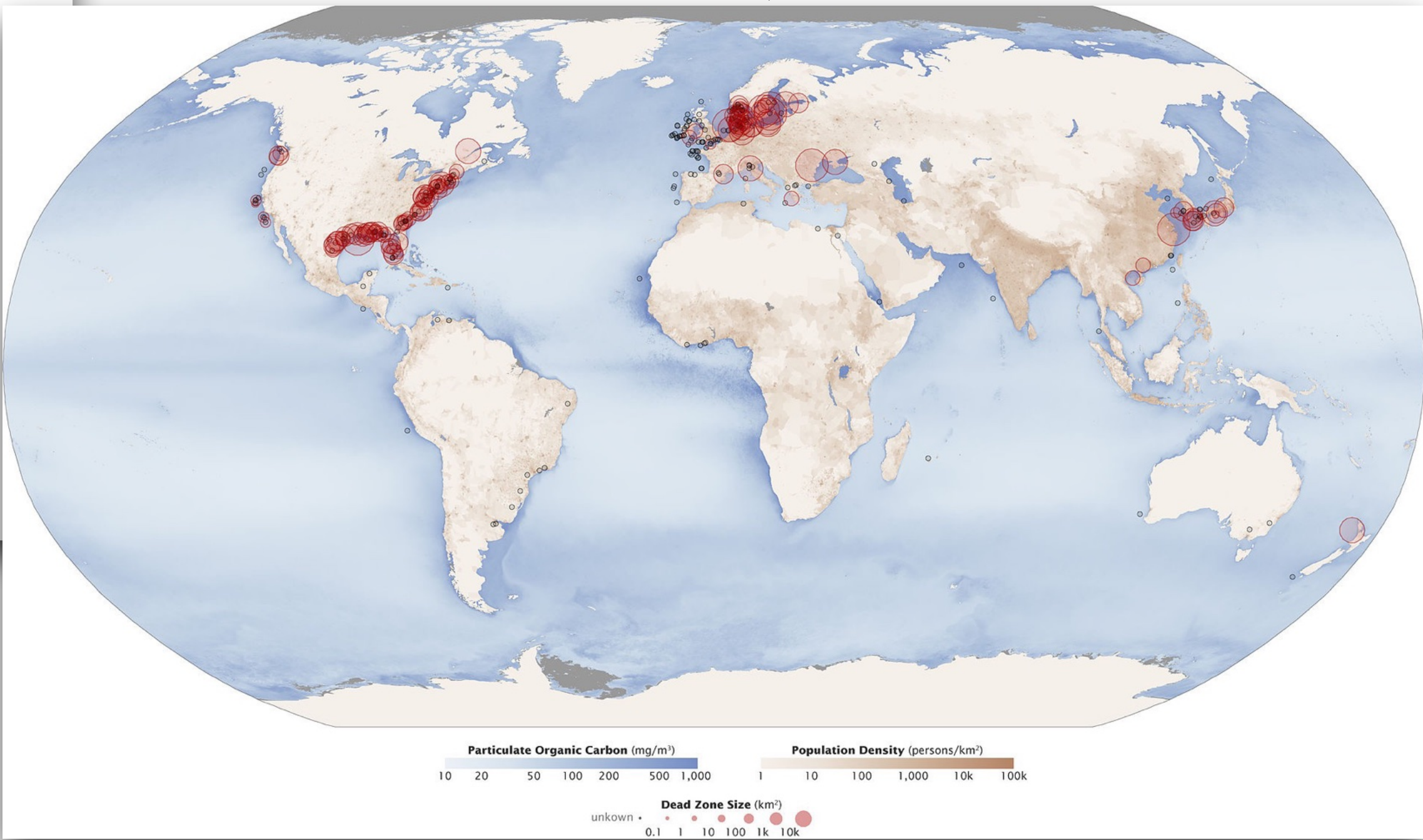
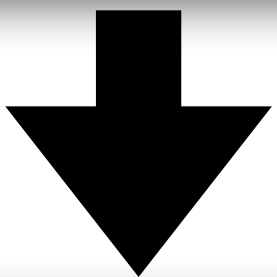
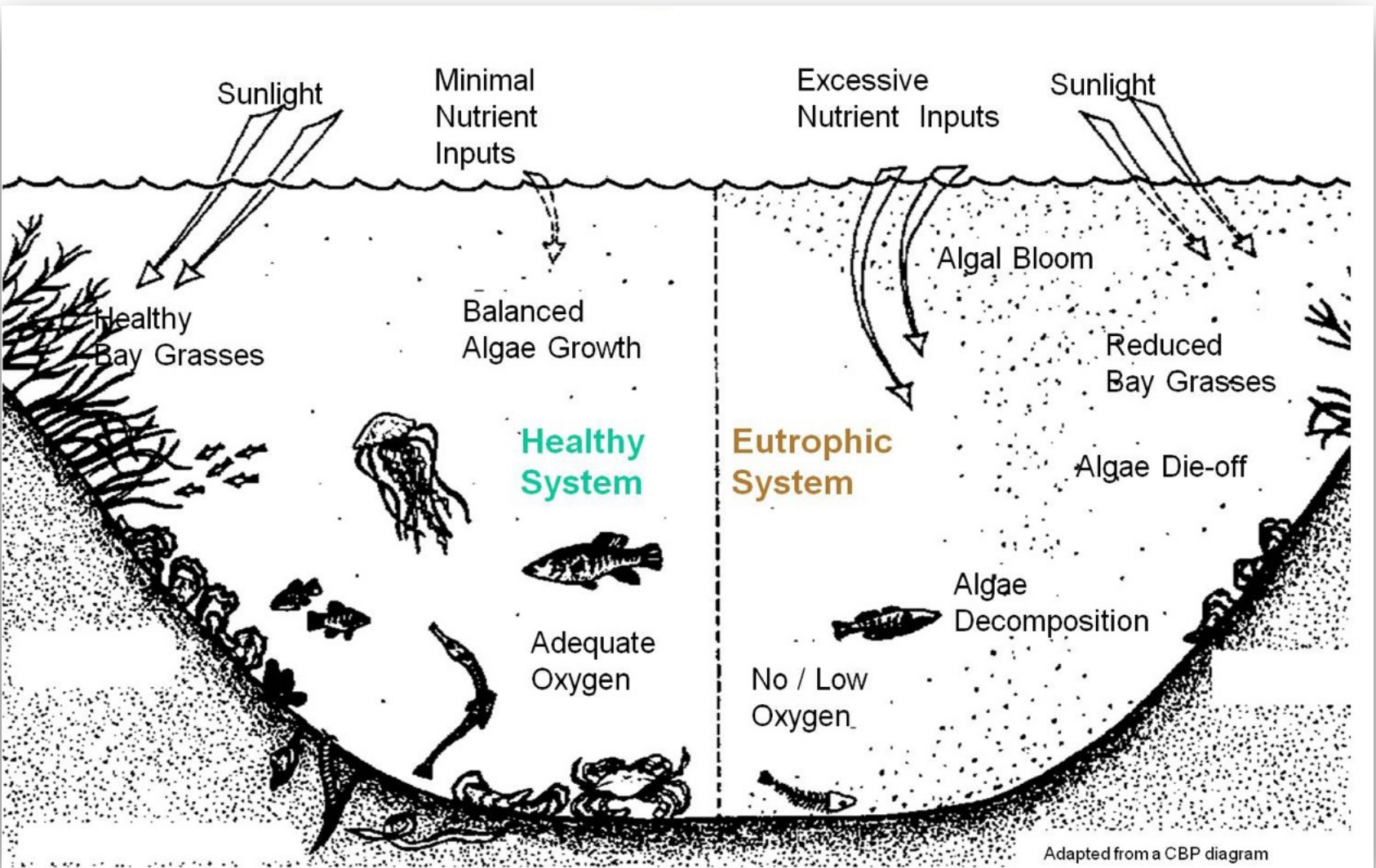
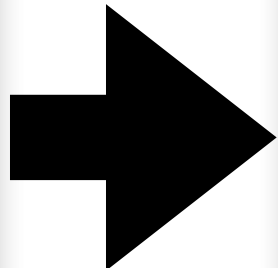


Copyright 2011. The Trustees of Columbia University in the City of New York.
Source: Potter, P., and N. Ramankutty, et al. (2010). Global Fertilizer Application and Manure Production.
Data distributed by the NASA Socioeconomic Data and Applications Center (SEDAC): <http://sedac.ciesin.columbia.edu/data/collection/fertilizer-and-manure>

Publication Date: 1/24/2011



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https://gulfeenvironmentnews.files.wordpress.com/2014/10/aquatic_dead_zones.jpg

NUTRIENT



<https://www.dailypioneer.com/2019/trending-news/scientists-track-indian-ocean-s-missing-plastic-waste.html>

MARINE DEBRIS



<https://oxfamblogs.org/fp2p/wp-content/uploads/2014/06/BP-oil-spill.jpg>



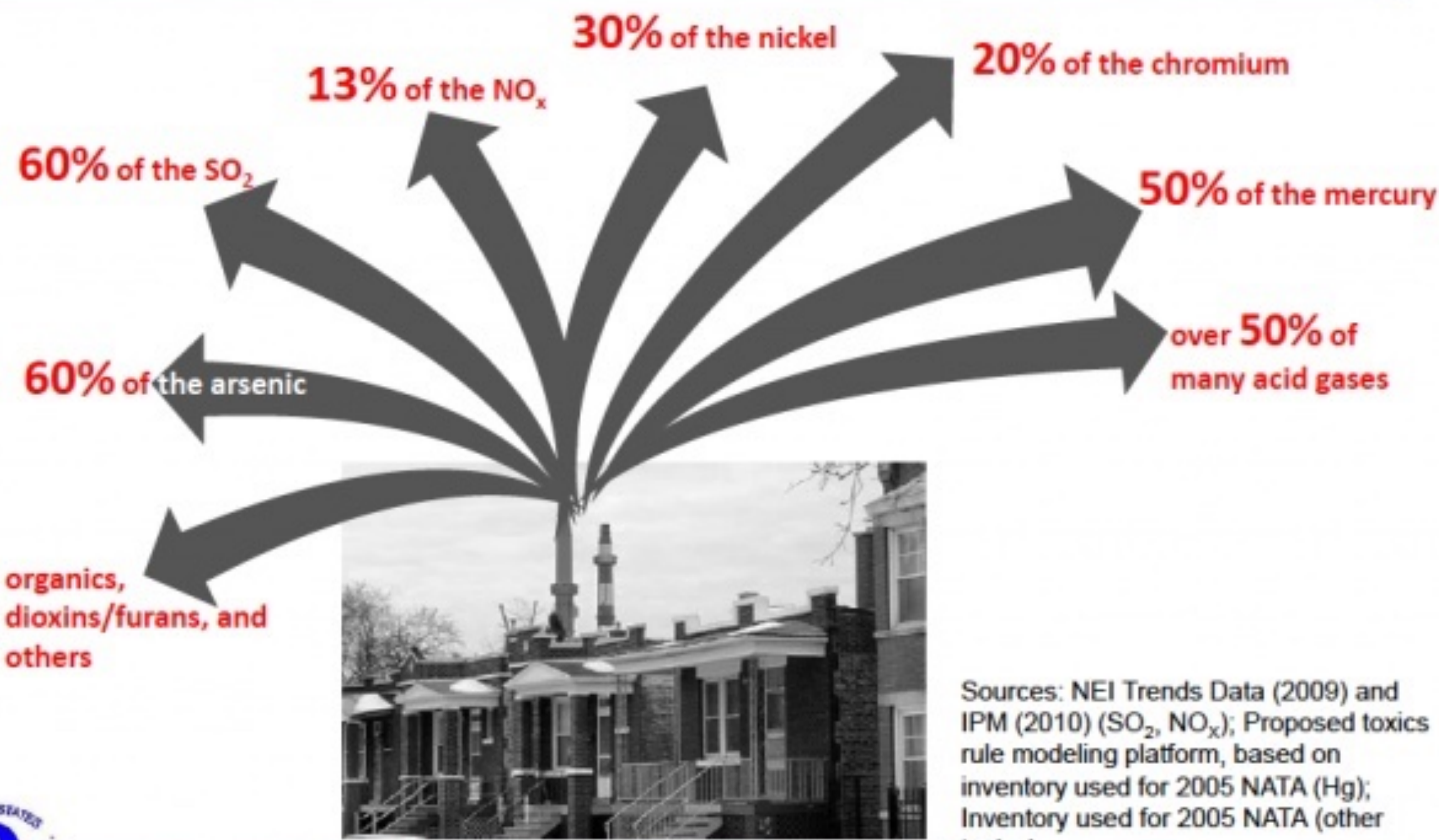
<https://fortunedotcom.files.wordpress.com/2015/01/ap10060312648.jpg?quality=80>



<http://www.gannett-cdn.com/-mm-/a1059ca0bfe0aeb953c0a2a7e5690c5ed92b30f9/c=0-132-4746-2813&r=x1683&c=3200x1680/local/-/media/2015/05/21/USATODAY/USATODAY/635678380139028553-AP-California-Oil-Spill.3.jpg>

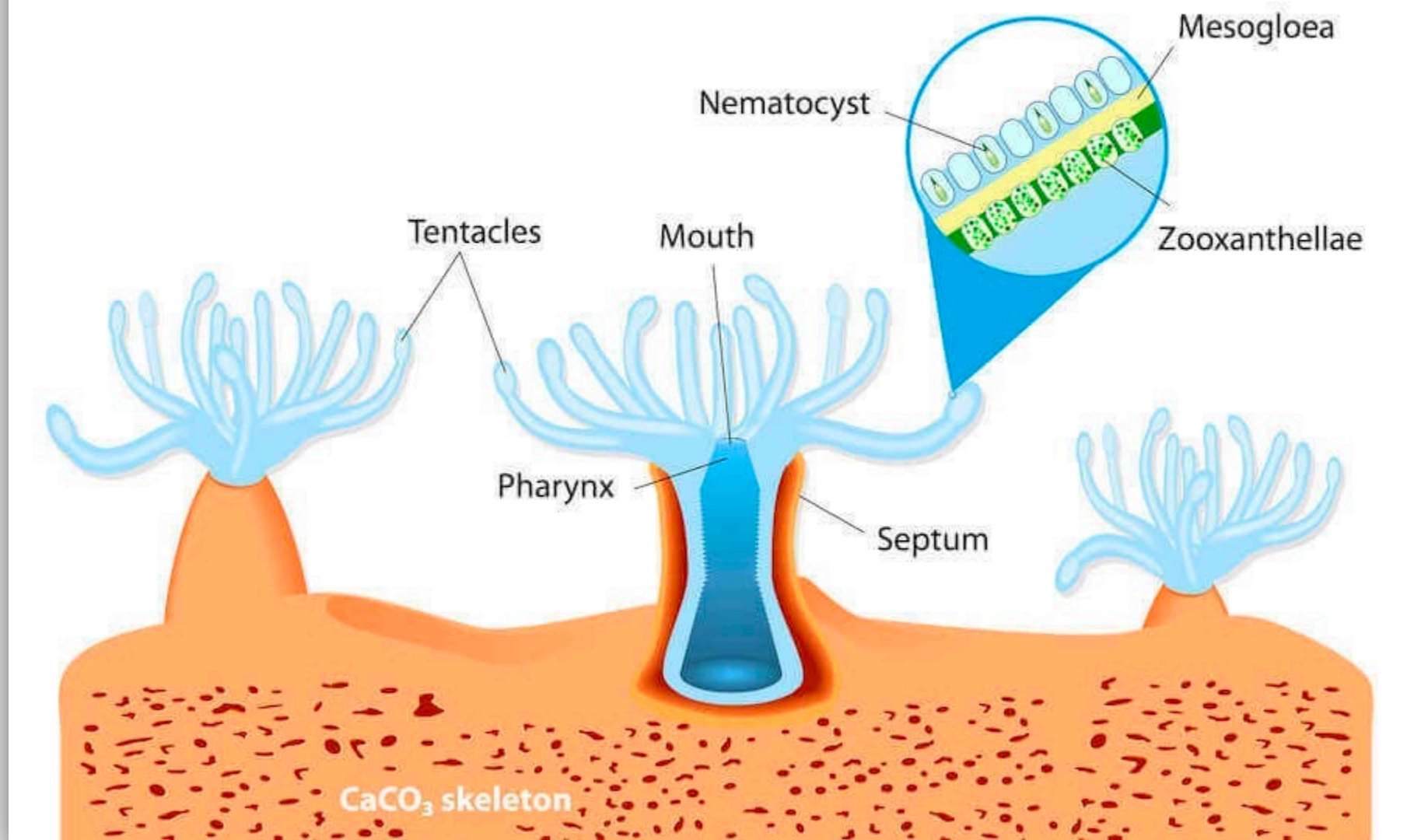
OIL & RELATED CHEMICALS

In the U.S., Power Plants Emit:

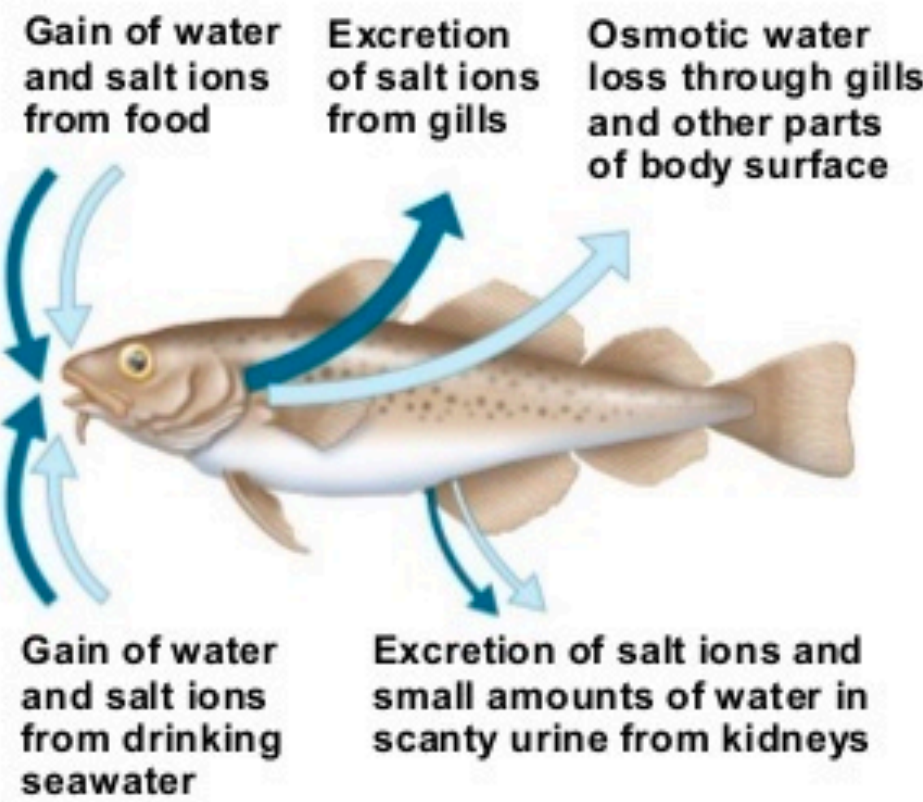


(HEAVY) METALS

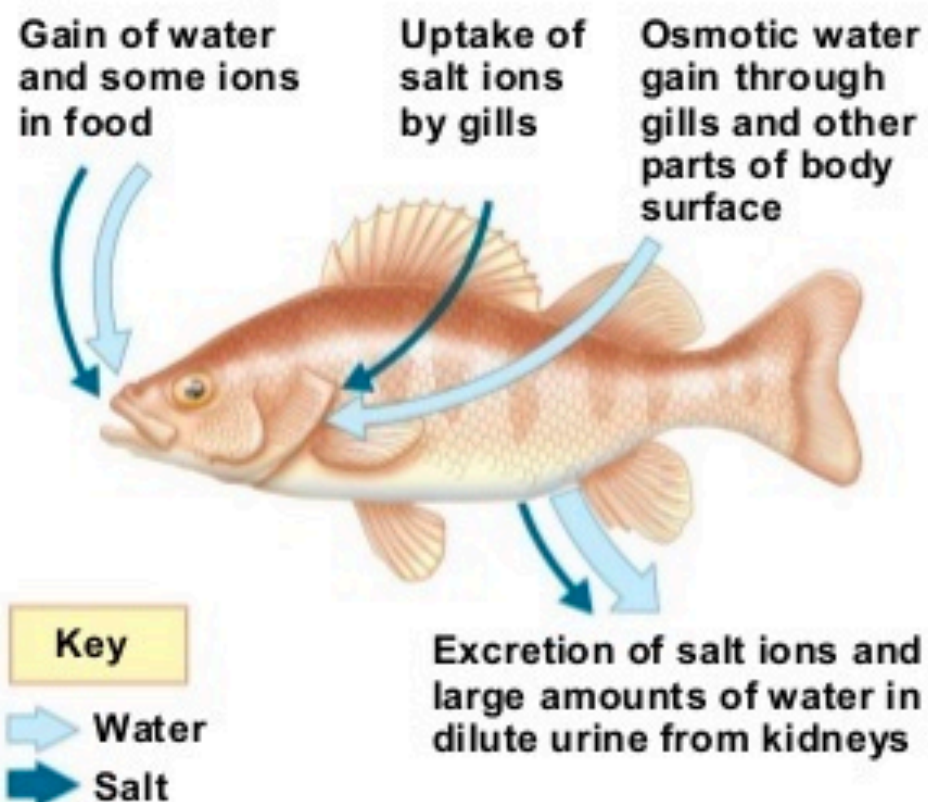
CORAL ANATOMY

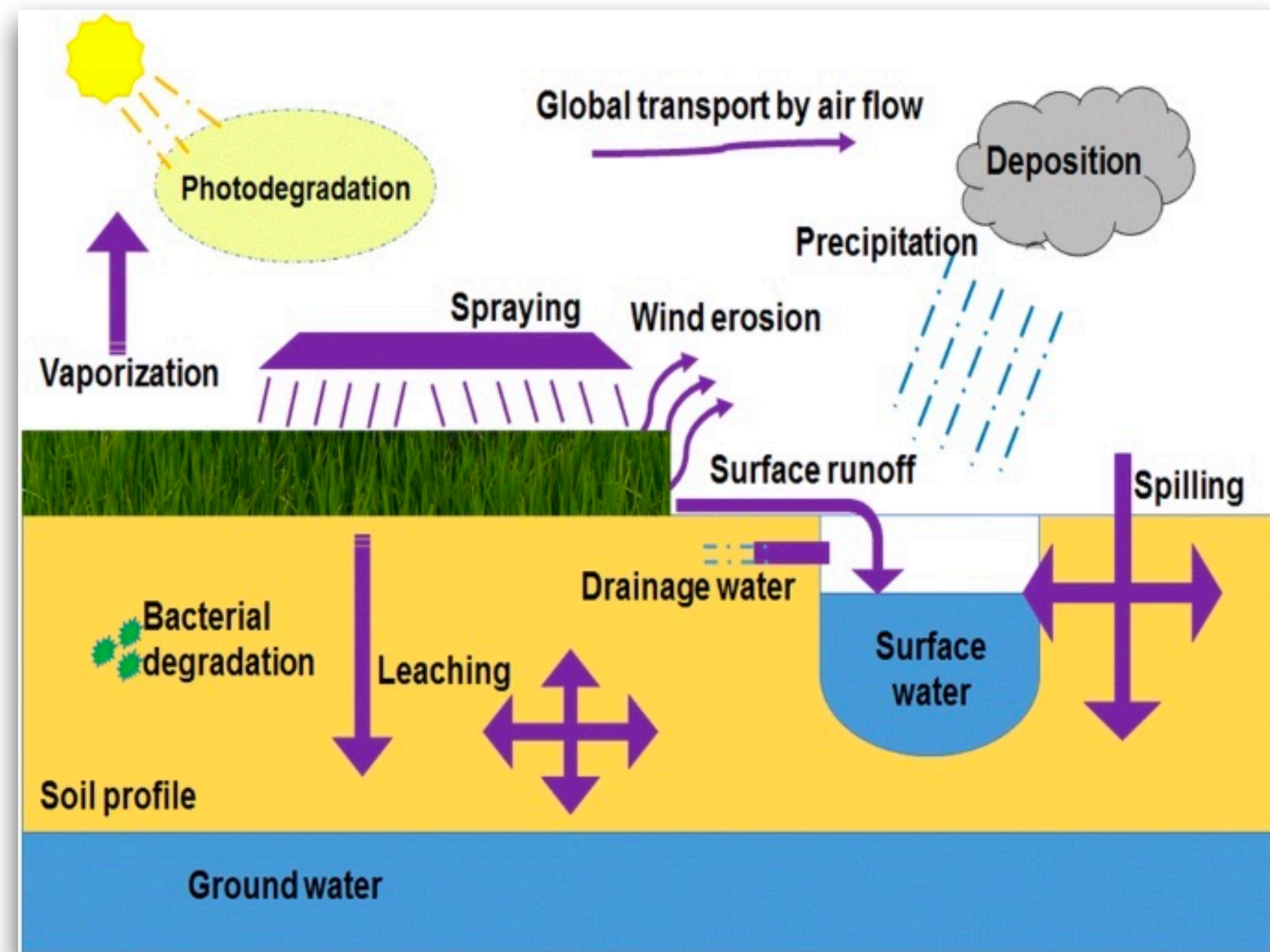


(a) Osmoregulation in a marine fish



(b) Osmoregulation in a freshwater fish





PESTICIDES & INDUSTRIAL ORGANIC CHEMICALS



ASIA PACIFIC

The New York Times

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In the Pacific, Outcry Over Japan's Plan to Release Fukushima Wastewater

The proposal has angered many of Japan's neighbors, particularly those with the most direct experience of unexpected exposure to dangerous levels of radiation.

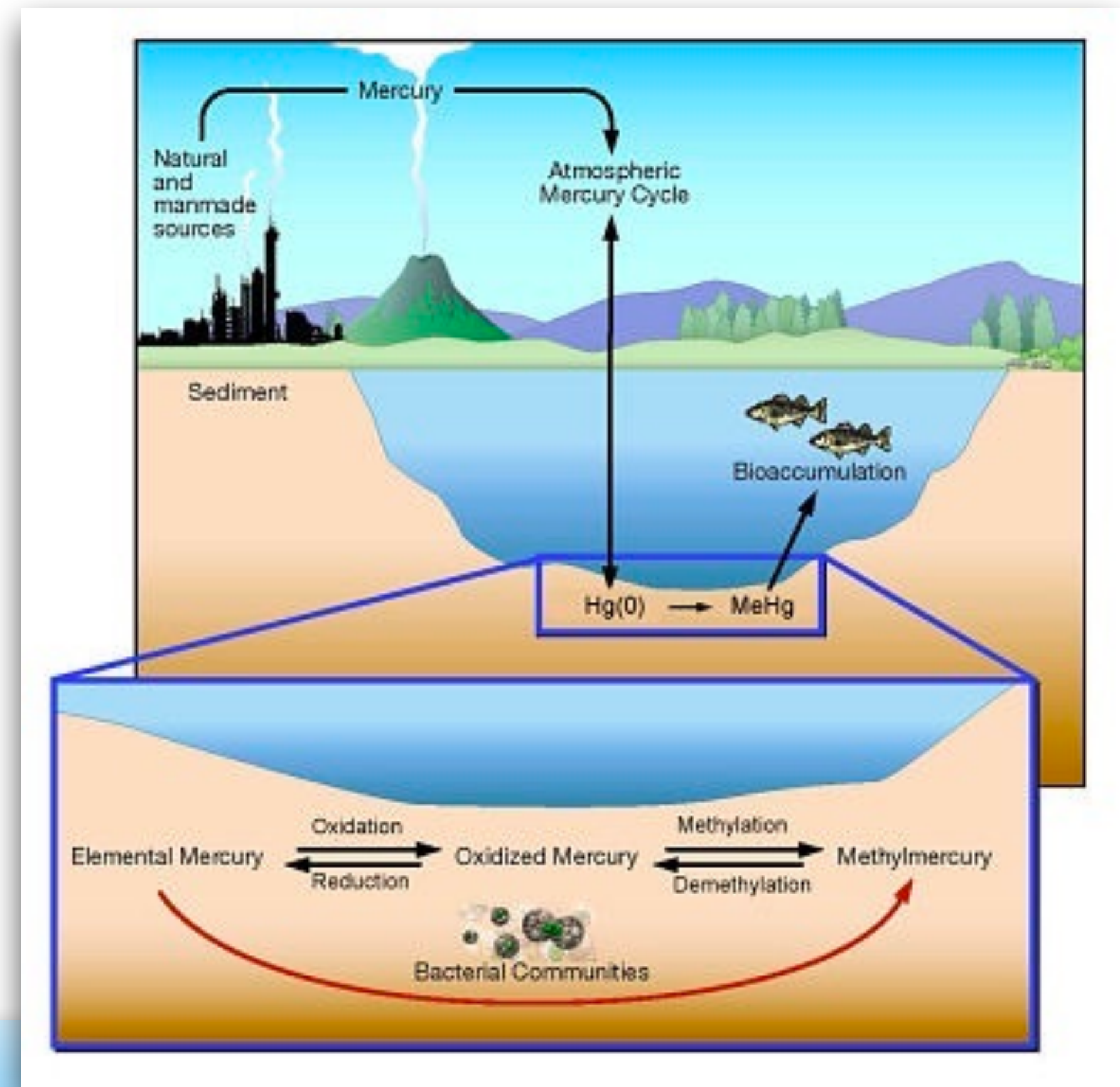
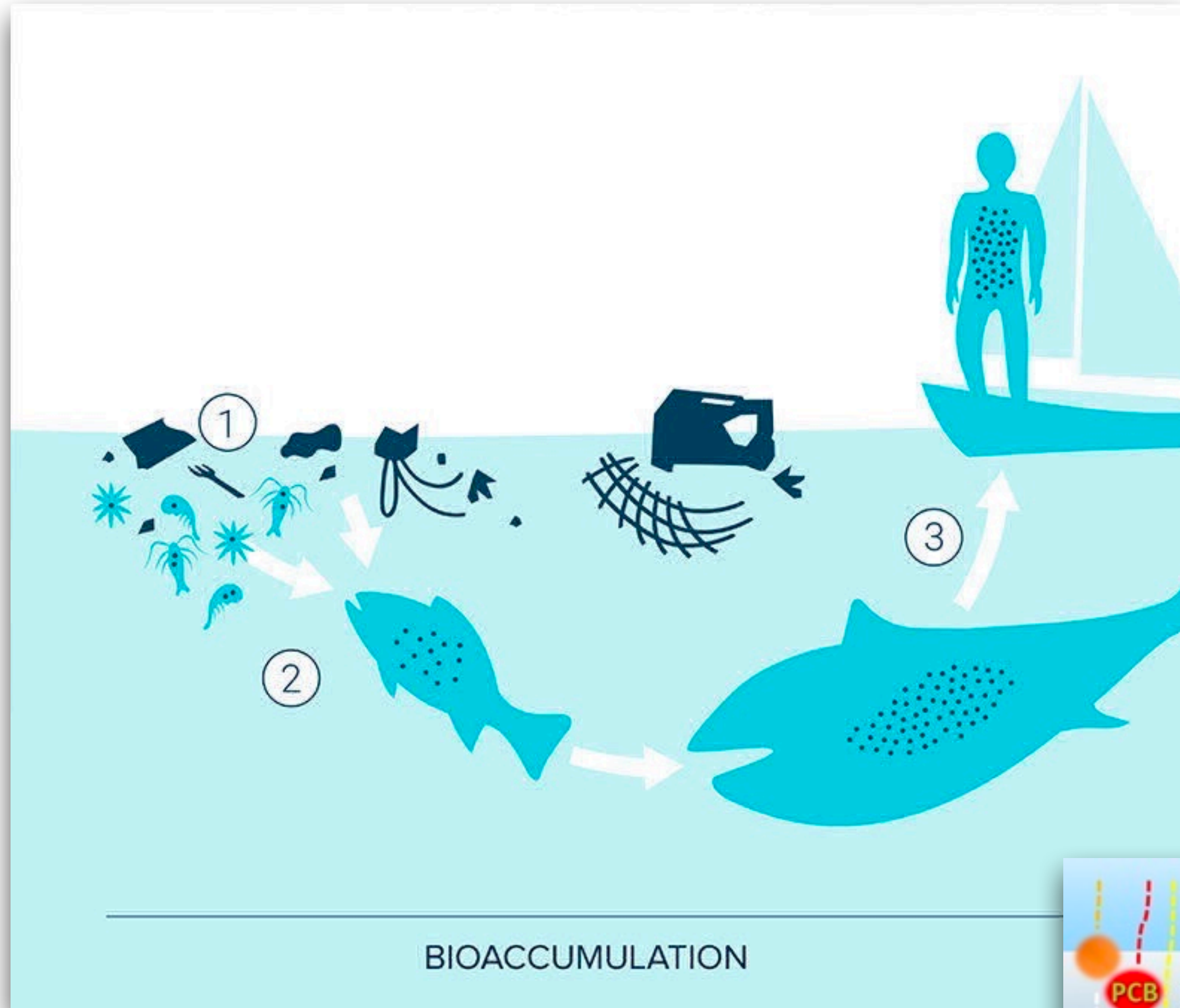
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An aerial photograph showing a large number of white, cylindrical storage tanks at the Fukushima Daiichi nuclear power plant. The tanks are arranged in rows, and the surrounding area includes some industrial buildings and infrastructure. The ocean is visible in the background.

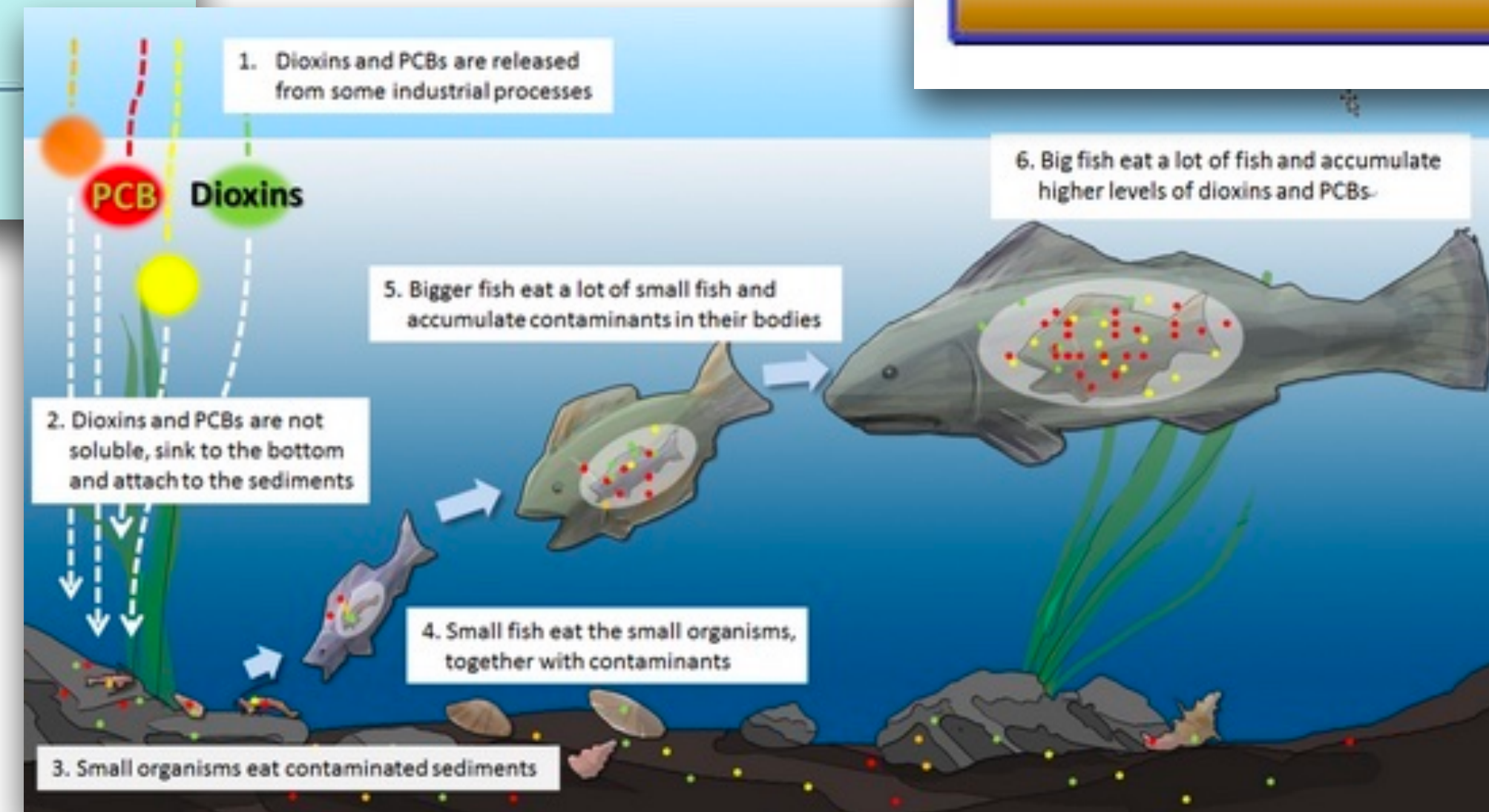
Tanks storing radioactive water at the Fukushima Daiichi nuclear power plant in Japan. The government plans to release the water, treated, but still slightly radioactive, into the Pacific starting in spring 2023. Ko Sasaki for The New York Times

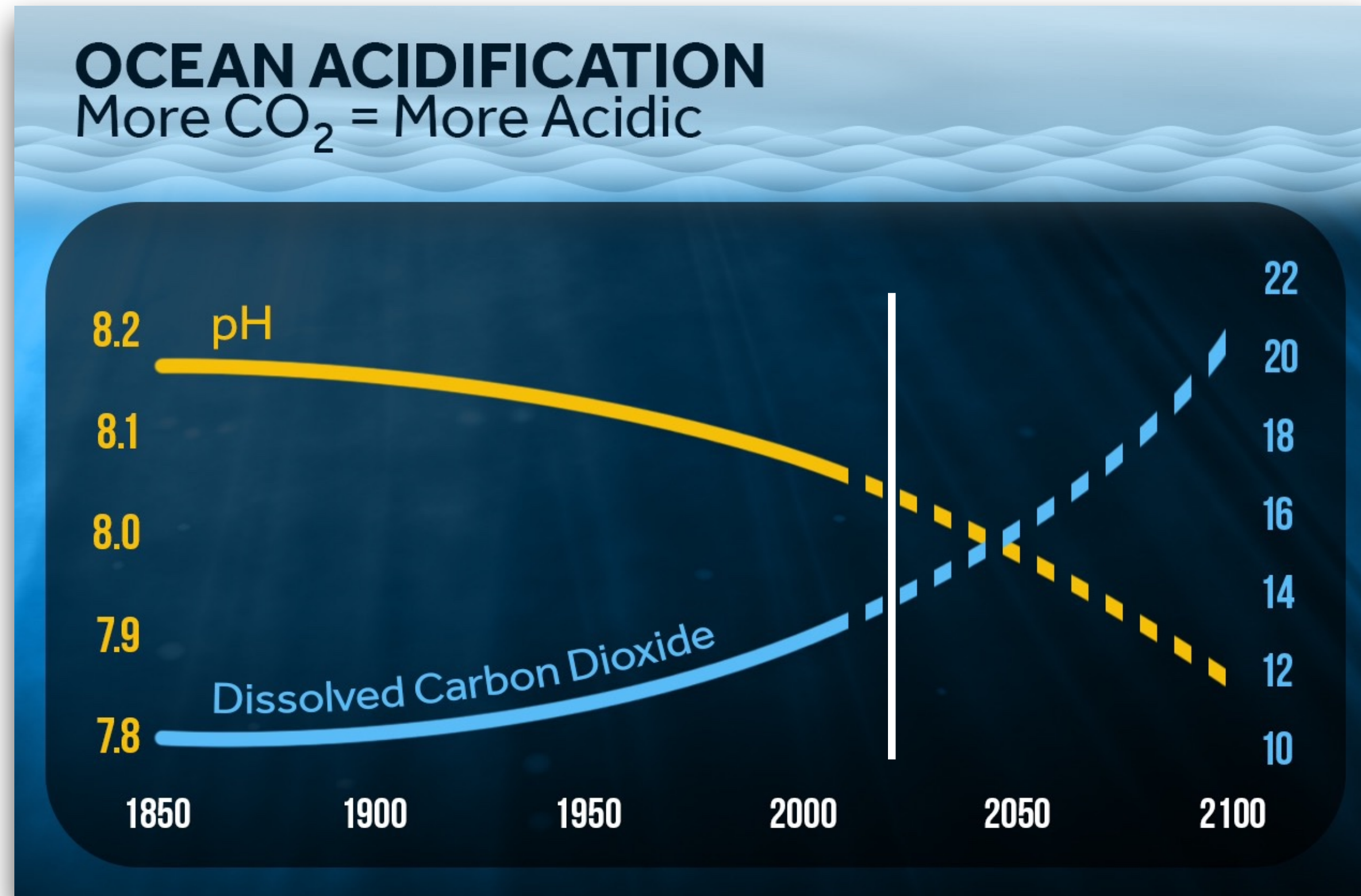
By Pete McKenzie
Dec. 30, 2022

EMERGING CONCERNS

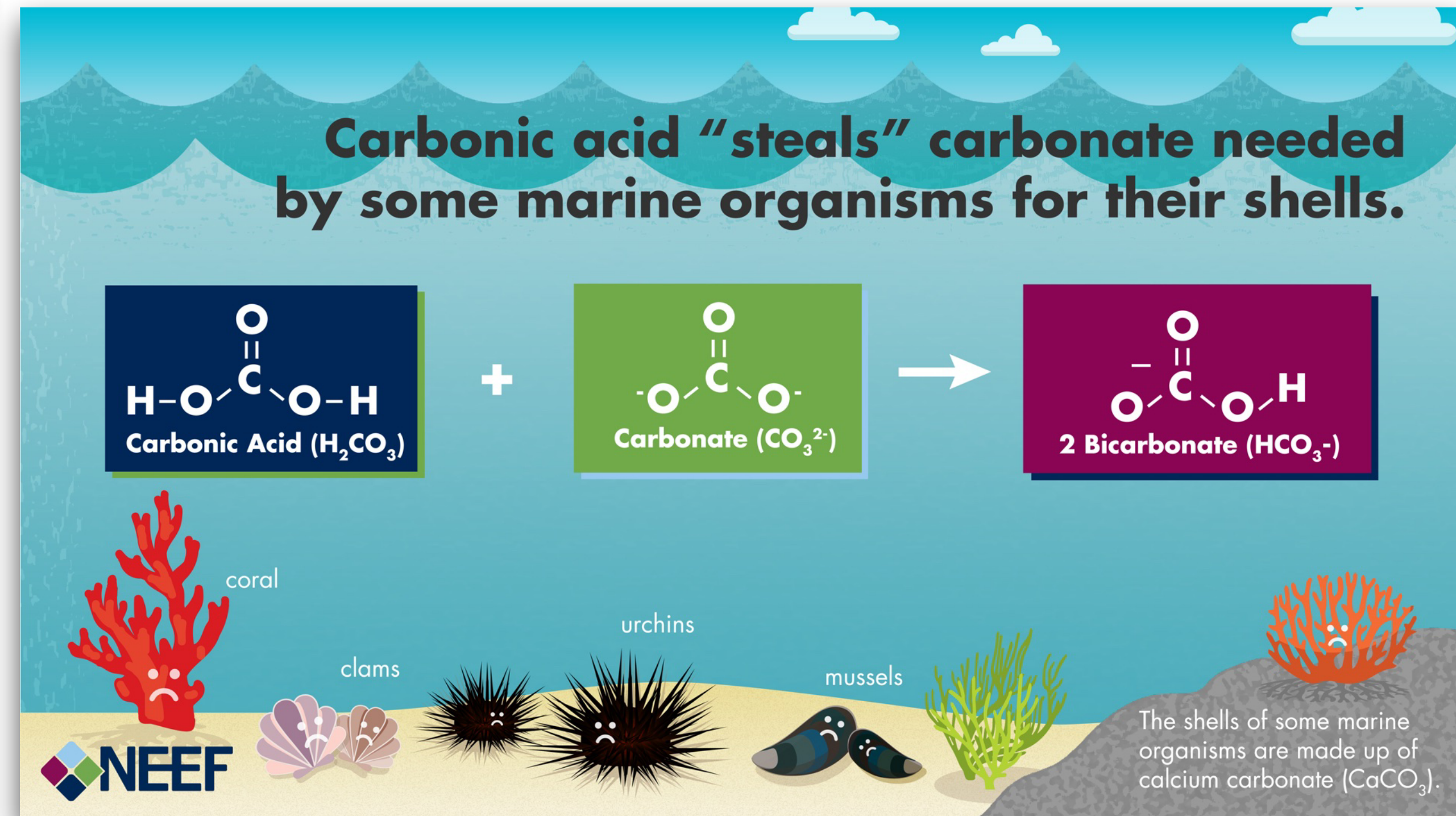


BIOACCUMULATION & BIOMAGNIFICATION





http://ccim.gs.s3.amazonaws.com/2015OceanAcidification/2015OceanAcidification_CO2Graph.jpg



https://www.epa.gov/sites/production/files/2016-11/ocean_acidification_2.jpg

CLIMATE CHANGE & OCEAN ACIDIFICATION



http://mediad.publicbroadcasting.net/p/northwestnews/files/styles/x_large/public/201405/052914TB_TsunamiDebris.jpg

BIOLOGICAL POLLUTION

Why do we need healthy marine ecosystems? (1)

Coastal habitats account for
~30% of all marine biological
productivity

Estuarine systems—like salt marshes,
seagrass beds, and mangrove forests
—are among the most productive
ecosystems on Earth



Why do we need healthy marine ecosystems? (2)

Some marine ecosystems, like coral reefs, support the highest variety of ocean life by providing food and shelter

The ocean also plays a vital role in the cycling of carbon, nitrogen, phosphorus, and other key nutrients



Declining health of our marine ecosystems (1)

Human activities have changed ocean chemistry in both coastal areas and the open sea

These changes—especially in carbon, nitrogen, and oxygen levels—affect how marine life functions

Years of pollution, habitat destruction, and overfishing have severely harmed ocean biodiversity and ecosystems



Declining health of our marine ecosystems (2)

Rising global demand for seafood has reduced many fish populations and hurt the economies of some coastal communities

At the same time, **climate change** is affecting the oceans in ways we are only starting to understand



Declining health of our marine ecosystems (3)

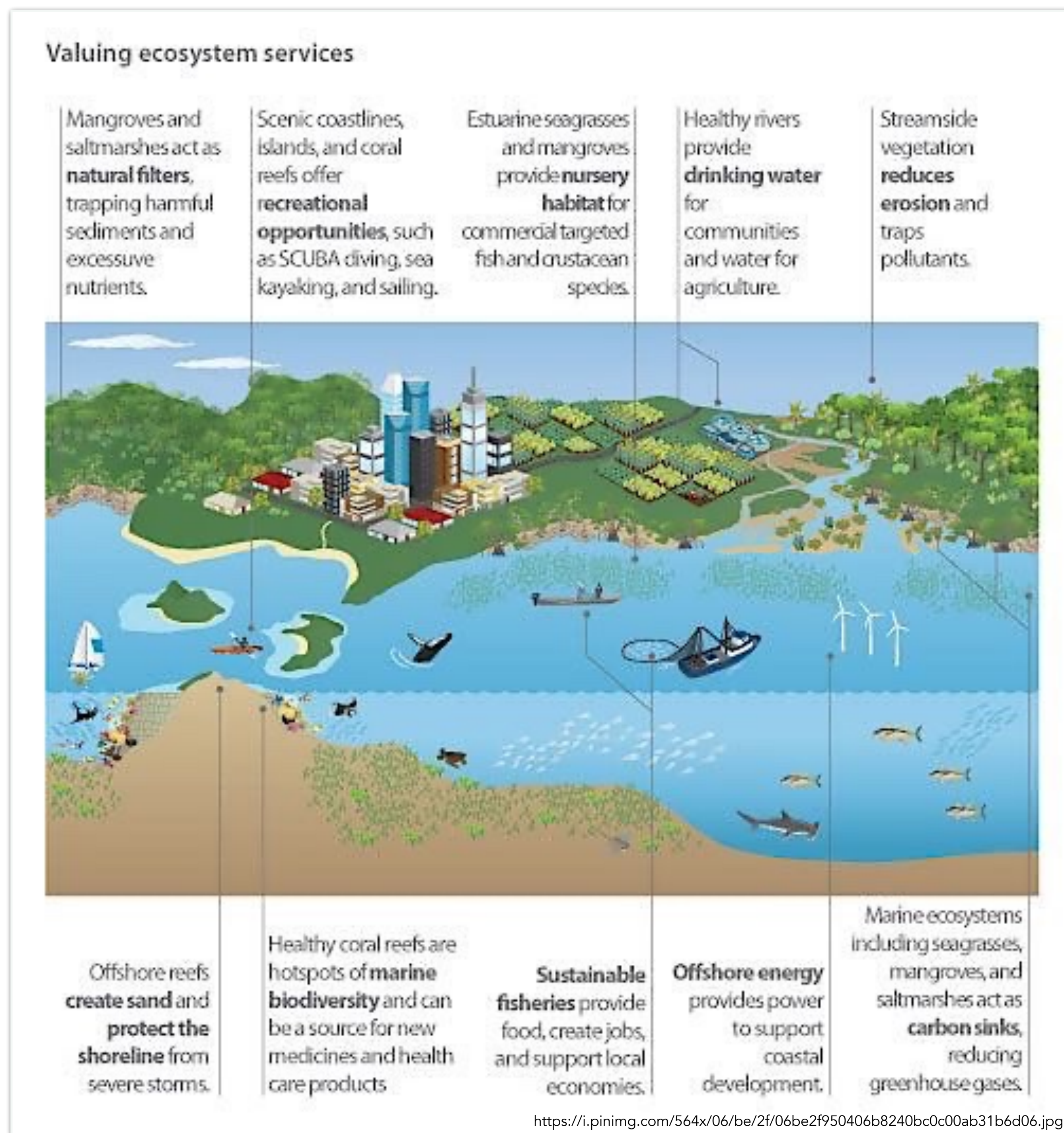
The most dangerous pollutants are those that spread widely, stay in the environment for a long time, build up in living things, and cause harm even in small amounts



http://www.seychellesnewsagency.com/media/images/2017-02/photo_verybig_6788.jpg

Ecosystem services

Ecosystem services are the benefits people get for free from nature and healthy ecosystems



**“ WE NEED TO RESPECT THE OCEANS
& TAKE CARE OF THEM AS IF OUR
LIVES DEPENDED ON IT.
BECAUSE THEY DO.”**

- SYLVIA EARLE



#EARTHTOPARIS

No ocean, no life.
No ocean, no us.

Sylvia Earle

Environmental & Marine Pollution Issues in Thailand



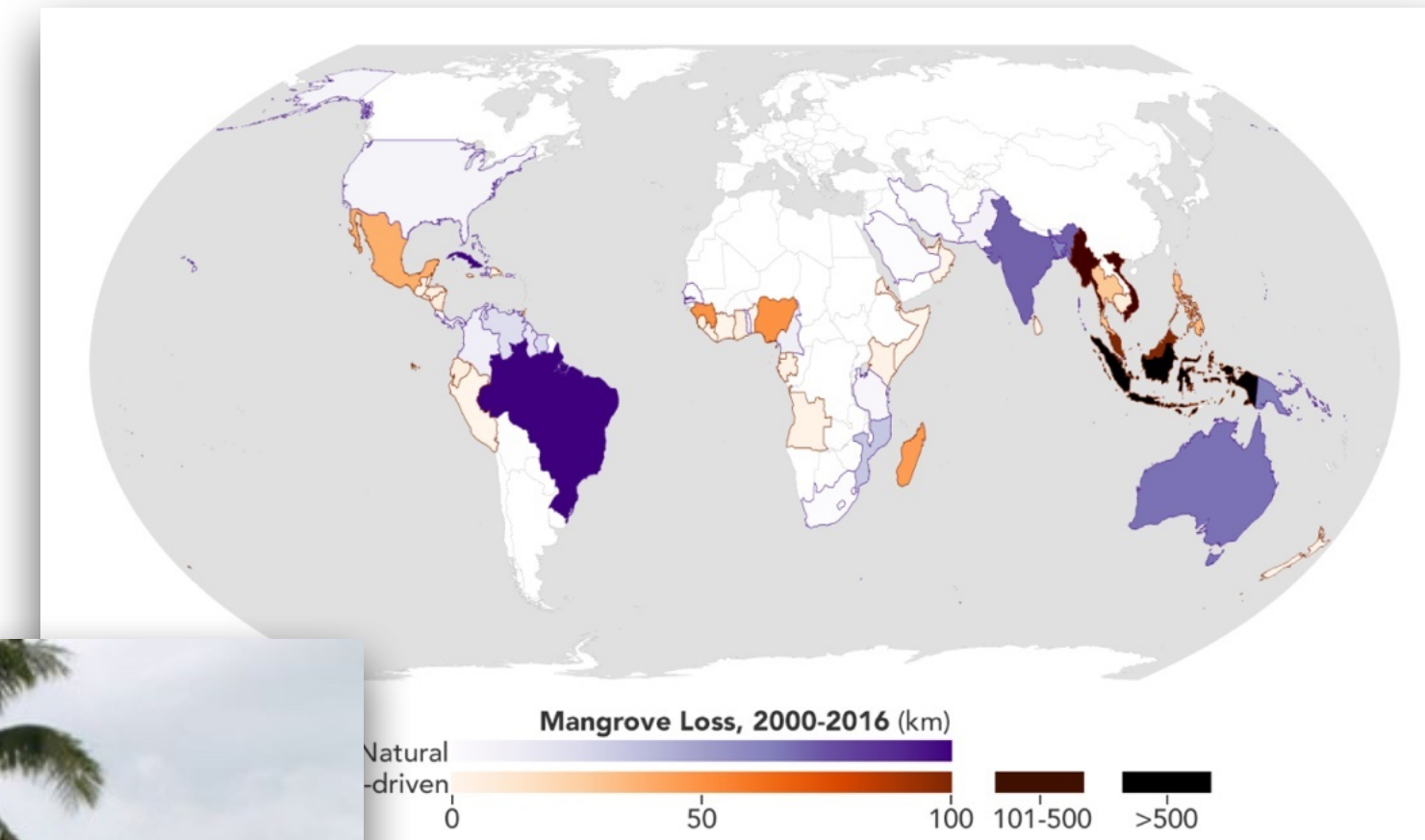
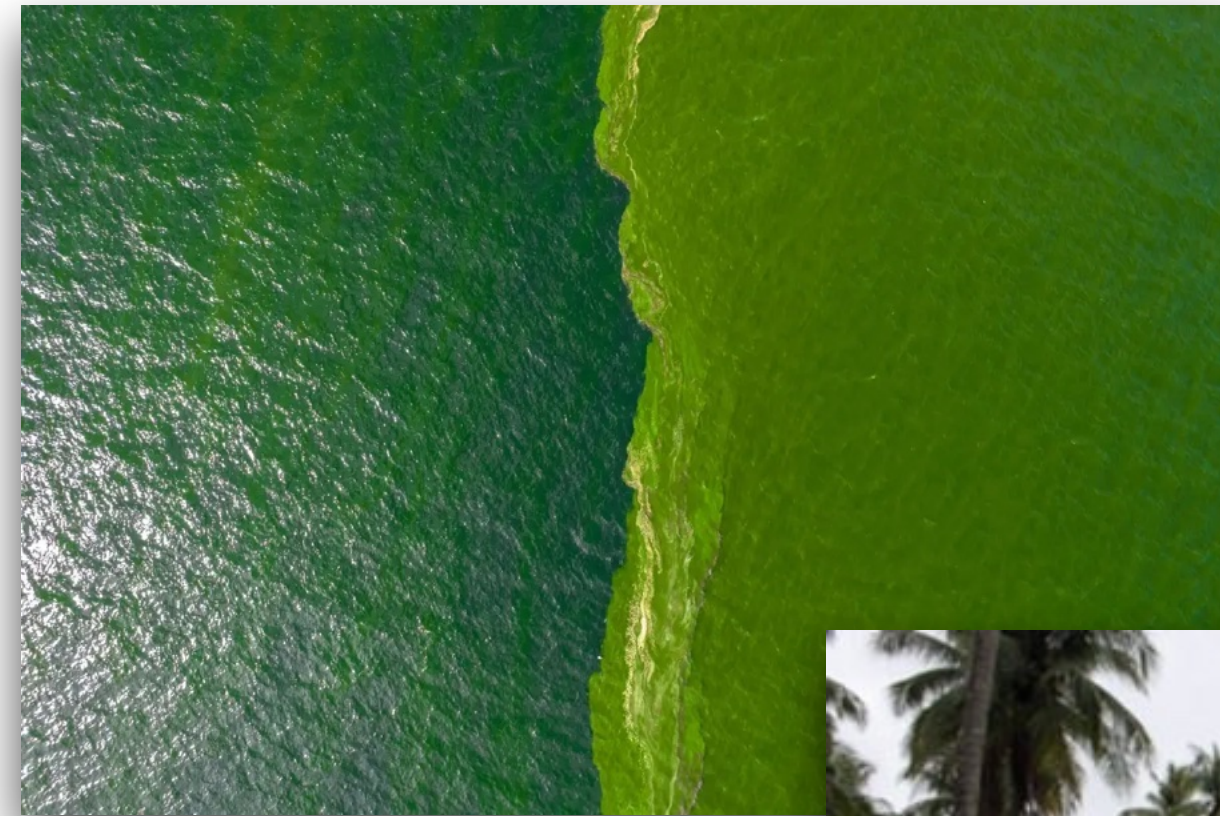
The Gulf of Thailand

- The Gulf of Thailand is one of 21 enclosed coastal seas recognized by the International EMECS Center
- It is located in Southeast Asia, just west of the South China Sea, and is bordered by Thailand, Cambodia, Malaysia, and Vietnam
- Millions of people rely on the gulf's fish and marine resources for their livelihoods, and many more are affected by changes in its environment

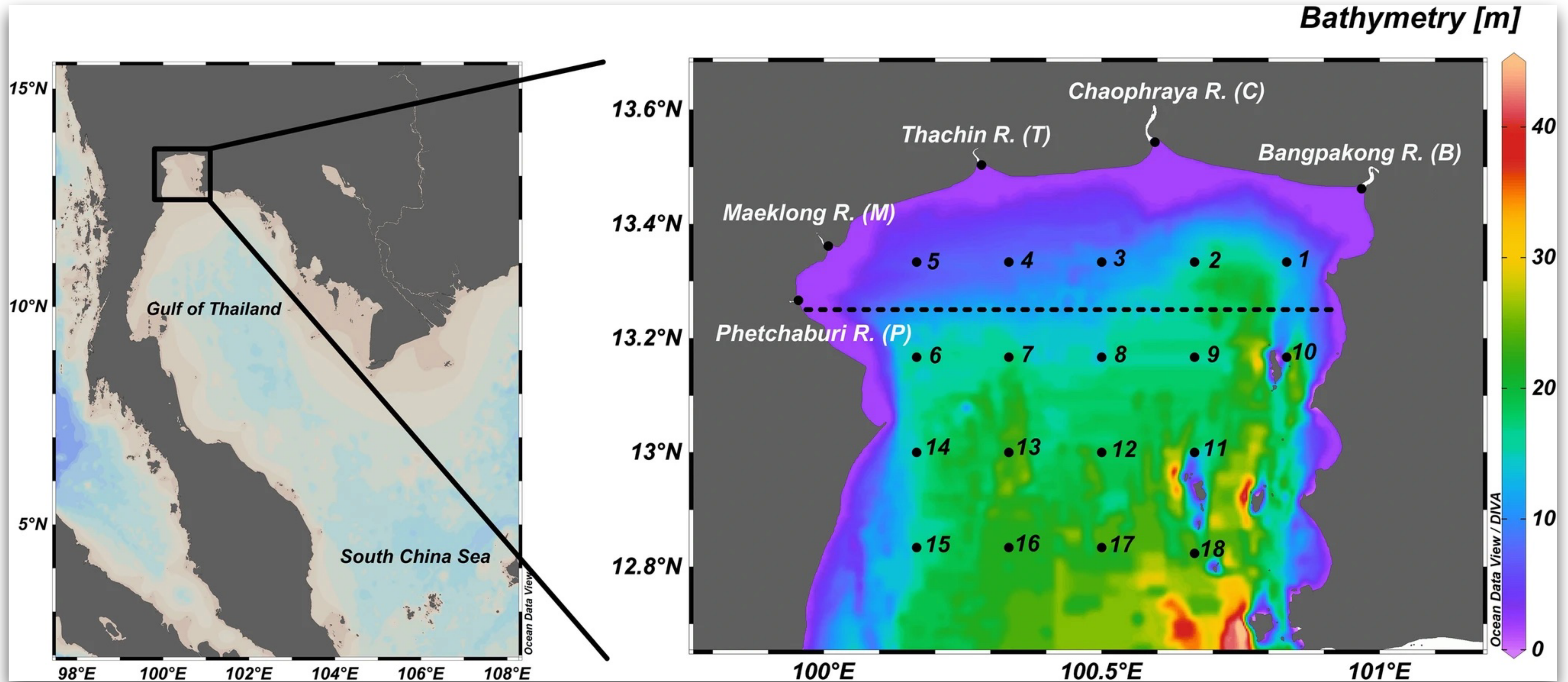


Major Environmental & Marine Pollution Issues

1. Nutrient / Eutrophication
2. Mangrove conversion and destruction
3. Persistent Chemicals
4. Coastal Erosion
5. Marine Litter (Debris)

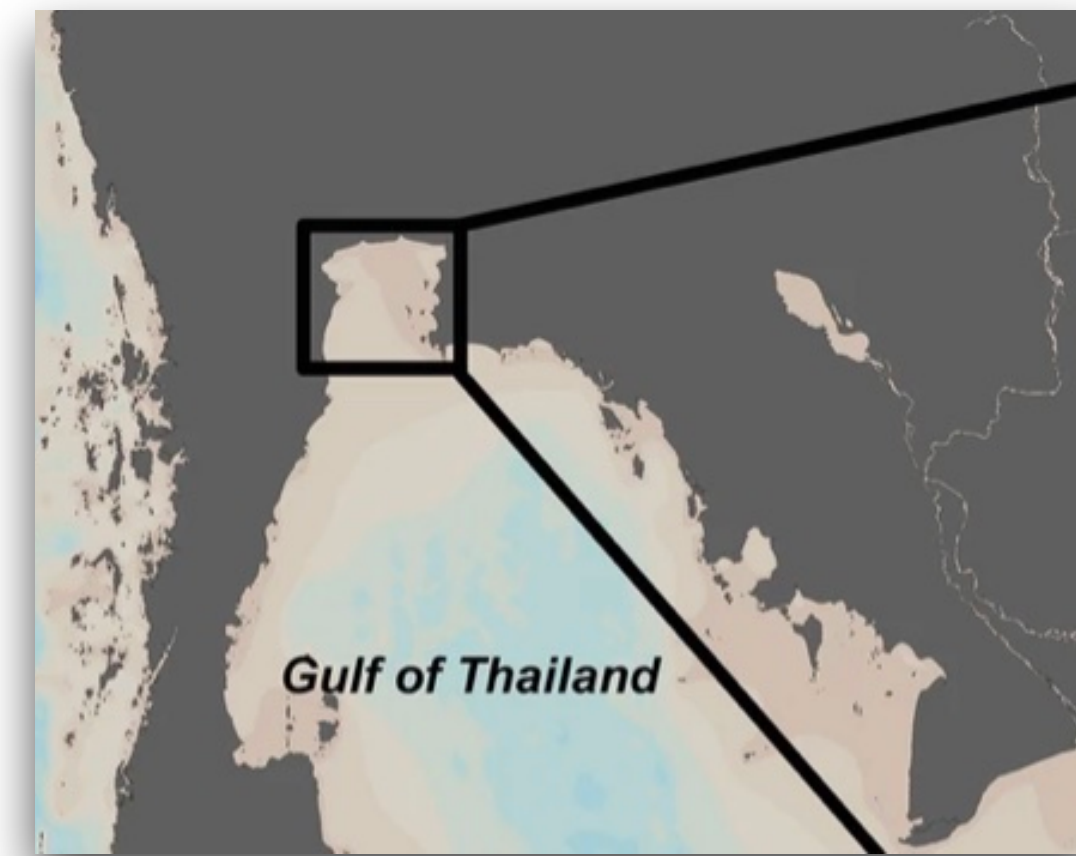


Gulf of Thailand (Inner Gulf)



1. Nutrient / Eutrophication

- Among the rivers flowing into the Gulf of Thailand, the Chao Phraya is the most polluted, especially near its estuary, because of growing cities and industries
- The main pollutants are organic wastes that increase oxygen use, bring harmful bacteria, make the water cloudy, and add too many nutrients (causing eutrophication)
- Since the upper gulf is partly closed off, these wastes tend to stay and build up
- Breaking down the organic waste can quickly lead to harmful algal blooms, like red or brown tides



Plankton infests Rayong beach waters

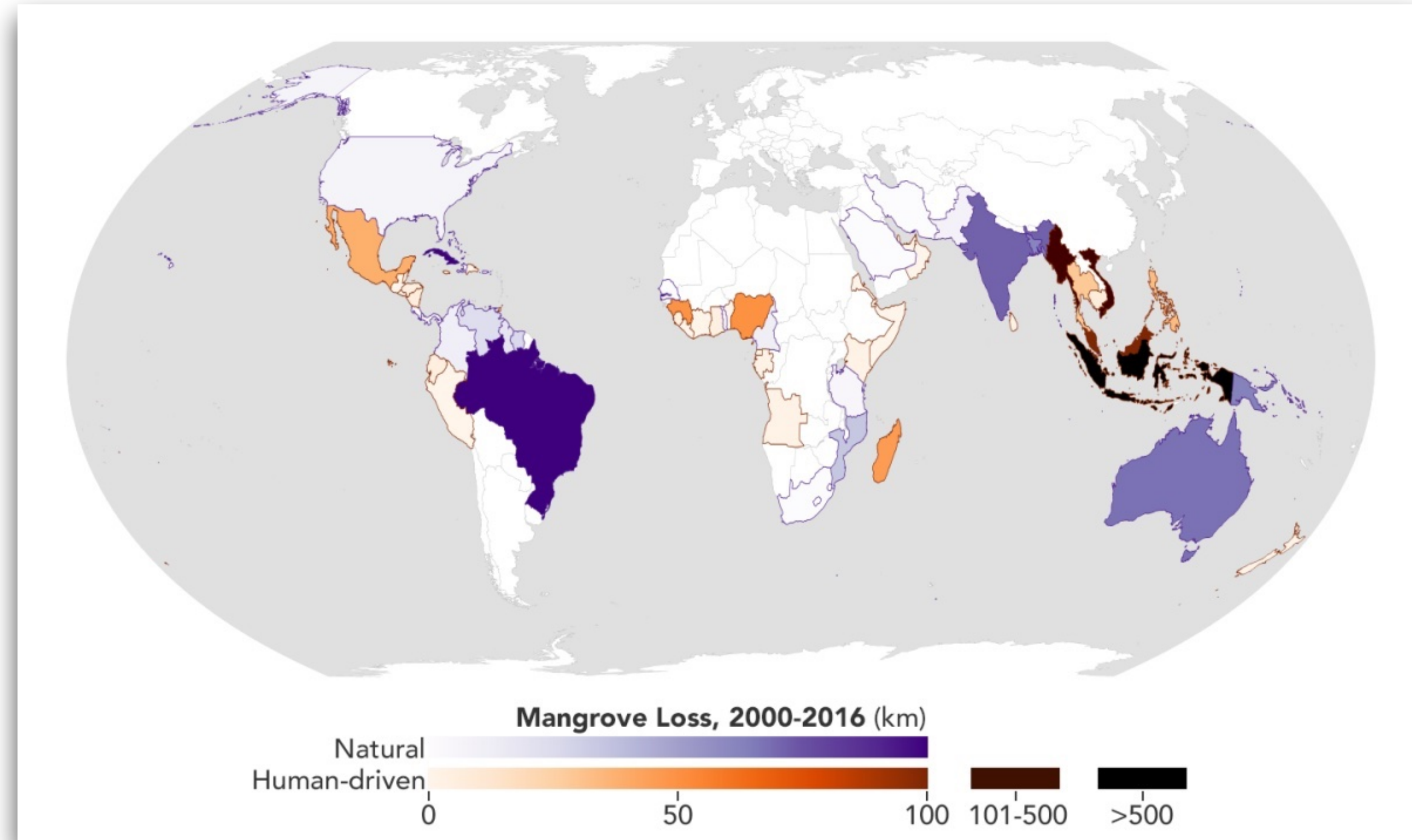
PUBLISHED : 4 OCT 2022 AT 06:00
NEWSPAPER SECTION: NEWS WRITER: APINYA WIPATAYOTIN



Algal bloom is seen along a 3-km stretch of the coast in Rayong, emitting a foul odour. (Photo by Department of Marine and Coastal Resources)

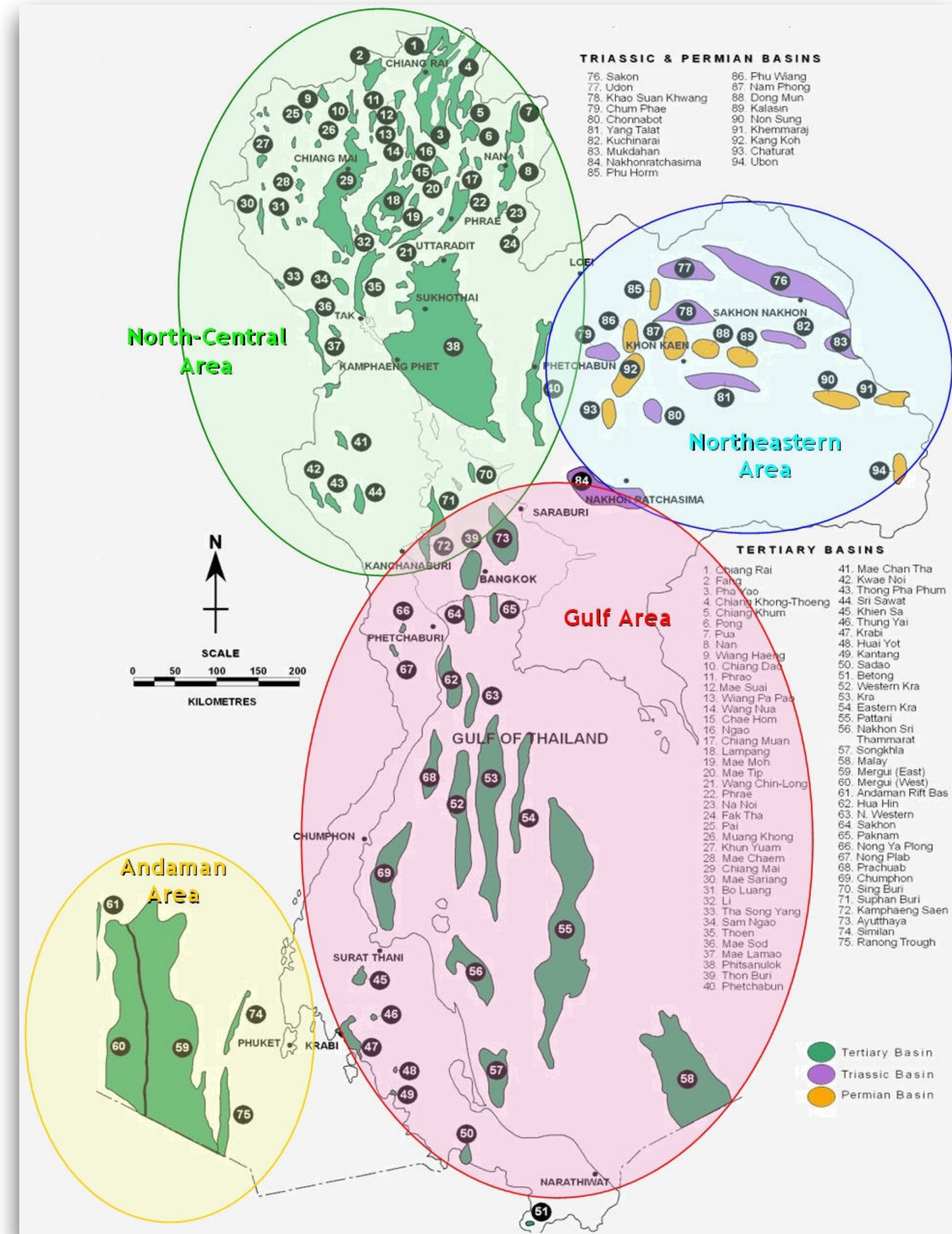
2. Mangrove conversion and destruction

- Mangrove areas **are being changed into** rice fields, coconut farms, fish and shrimp ponds, salt ponds, cities, landfills, and factories
- Mangroves are also being **overused** for timber, firewood, and charcoal
- There is **not enough effort** to help mangroves grow back after they are cut down



3. Persistent Chemicals

- Thailand produces oil and natural gas, mostly from offshore fields in the Gulf of Thailand
- Oil spills and other pollution often happen along shipping routes and near oil company operations, especially in the Gulf
- Since 1974, there have been at least 240 oil spills in Thai waters



4. Coastal Erosion

- Thailand has over 3,000 km of coastline across 23 provinces, and more than 800 km of it is being damaged by sea erosion
- Some of this erosion is caused by human activities like building on the coast, turning mangroves into shrimp farms, industrial growth, and actions that lower the land, such as pumping water or digging soil
- Natural forces like waves, strong tides, and storms also cause erosion



5. Marine Litter (Debris)

- Marine debris affects ecosystems, fishing, aquaculture, human health, and food safety
- Many marine animals like mammals, reptiles, and birds get tangled in or eat this debris, causing injuries and often death
- Debris also collects in shallow coral reefs, carried by winds and tides, which damages the reefs a lot



https://www.thailand.go.th/issue-focus-detail/001_04_027

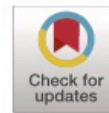
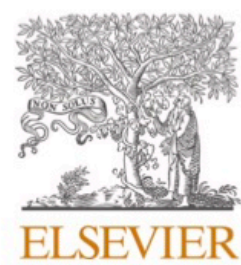


<https://news.cornell.edu/stories/2018/01/oceanic-plastic-trash-conveys-disease-coral-reefs>

Marine Litter (Debris)

- Thailand is ranked as the sixth largest source of marine debris in the world
- Many types of trash are found along its coastlines, often linked to local economic activities
- Most of the debris includes plastic bottles, caps, lids, food and drink containers, rubber bands, and cigarette butts





Microplastic contamination in edible marine fishes from the upper Gulf of Thailand

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^c Marine Research Group, Loma Linda University, Loma Linda, CA 92350, USA

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Marine contamination
Exposure assessment
Health impacts

ABSTRACT

Seafood consumption is a major source of microplastic exposure for humans. Here, we demonstrated microplastic contamination in marine food fishes from the upper Gulf of Thailand. Microplastics were found in gastrointestinal tracts of 46.9 % of fishes sampled, with a mean concentration of 1.6 ± 0.5 pieces per fish or 0.04 ± 0.01 pieces/g of fish tissue. Demersal fishes had higher contamination rates than pelagic fishes. Fibrous-type and blue-colored materials were the most abundant microplastics, while the most common polymers were polyester and polyethylene. No associations between microplastics and histopathological changes were detected. Estimated daily microplastic exposure for human marine fish consumers was 0.03 to 0.1 pieces per person. Although we expect a low risk of microplastic contamination in fish muscle because of very low calculated transfer rates, we recommend continuing surveillance, including evaluations of contamination in the food chain to ensure future seafood safety in this region.

ABSTRACT

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2022). Most virgin microplastics are chemically inert and cause little direct chemical harm to fishes (Jovanović, 2017; Jovanovic et al., 2018), such as causing increased oxidative stresses in shrimp by polyethylene

fish than plastics or contaminants alone. These effects included alteration of liver gene expression and hepatic vacuolation. As a spillover effect, toxicity and accumulation of these contaminants in fish may be

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Microplastics

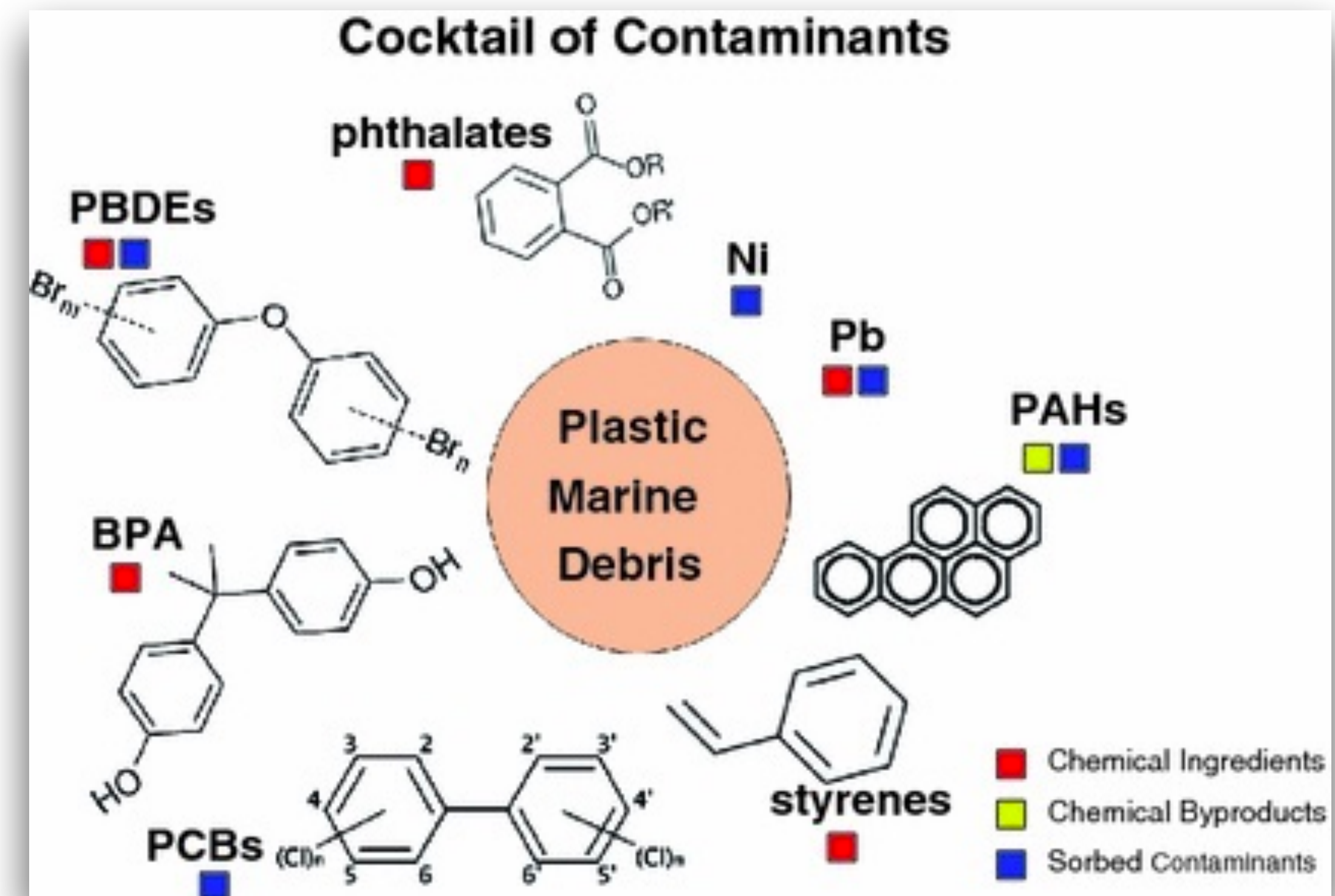
- Over 80% of the world's ocean plastic pollution comes from Asia
- In Thailand, plastic use grows by about 7–8% each year
- On average, each person uses around eight plastic bags daily, adding up to about 200 billion bags every year



Dangers of Microplastics

- Microplastics can hold harmful chemicals called POPs
- These toxins can enter the food chain and cause problems like reproductive issues and behaviour changes in marine animals
- All sea turtle species, 45% of marine mammals, and 21% of sea birds have been affected by marine debris.
- A study of microplastics in the North Pacific found that 50% contained PCBs, 40% had pesticides, and 80% had PAHs

"Persistent Organic Pollutants (POPs), Polychlorinated Biphenyls (PCBs), Polycyclic Aromatic Hydrocarbons (PAHs)



Marine plastic debris carries a mix of contaminants. These include chemicals used in making the plastics (red squares), byproducts from manufacturing (yellow squares), and pollutants picked up from the ocean water around them (blue squares)."

What can be done about this pollution?

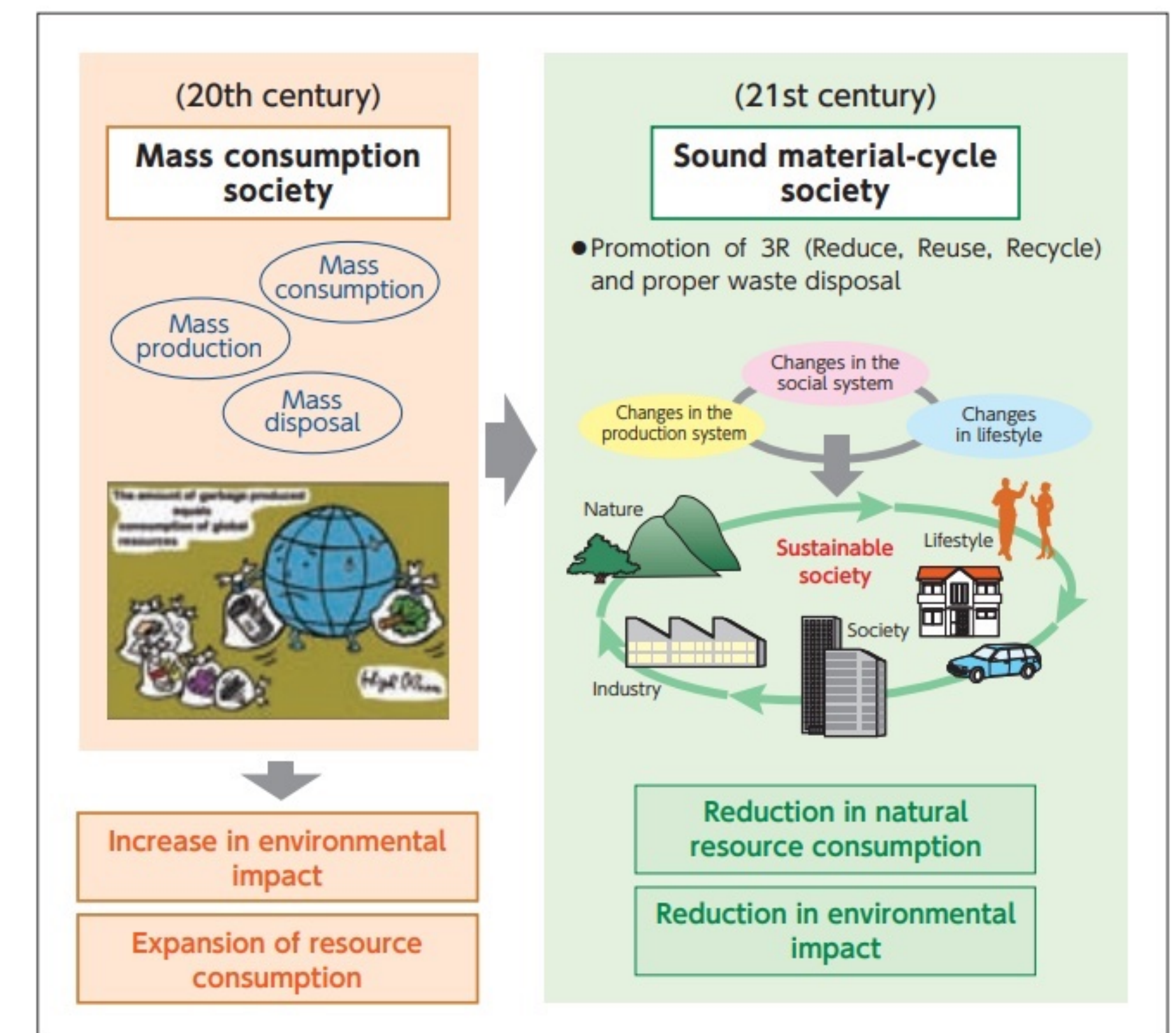
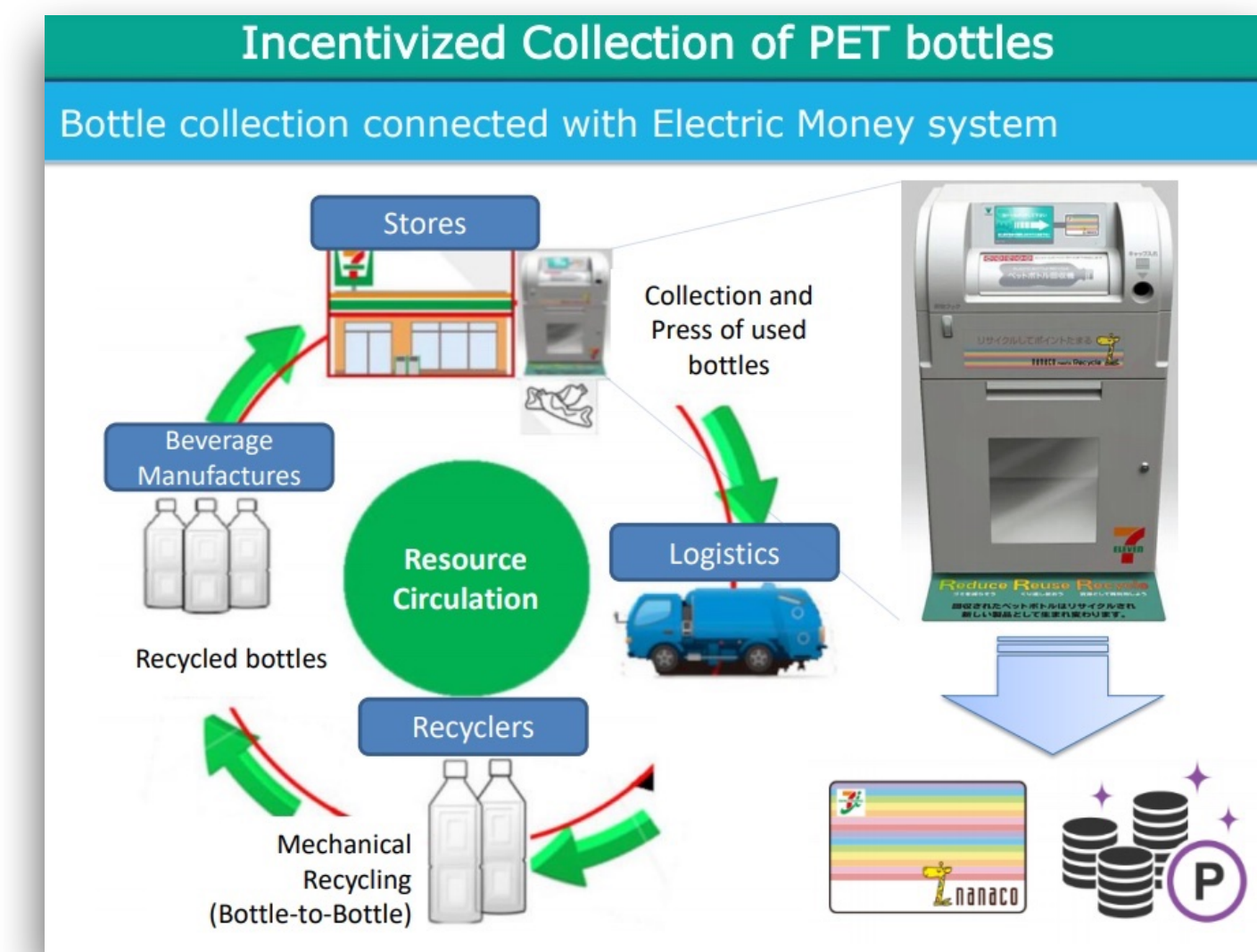
1. Eutrophication
2. Mangrove conversion and destruction
3. Persistent Chemicals
4. Coastal Erosion
5. Marine Litter (Debris)



- About 80% of plastic litter comes from land
- It reaches the ocean through rivers, drains, storm runoff, factories, beachgoers, poor waste management, and illegal dumping
- The main reasons are: (1) lack of political will to make changes, (2) poor waste management systems, and (3) not enough responsibility taken by both public and private sectors to reduce plastic waste

Some lessons from Japan??

- Japan produces a lot of plastic but has an effective waste management system that keeps plastic pollution in the ocean low
- In contrast, 80% of Thailand's marine plastic pollution comes from poorly managed land waste
- There is little public habit in Thailand of sorting and cleaning plastic waste. The head of the Thai Plastic Club said that if Thais were taught like people in Germany and Japan, they would separate and clean their trash
- Unlike Japan, Thailand does not have a national agency to coordinate waste management



Source for the illustration: Website of the Miyako Ecology Center



Thank you for your attention